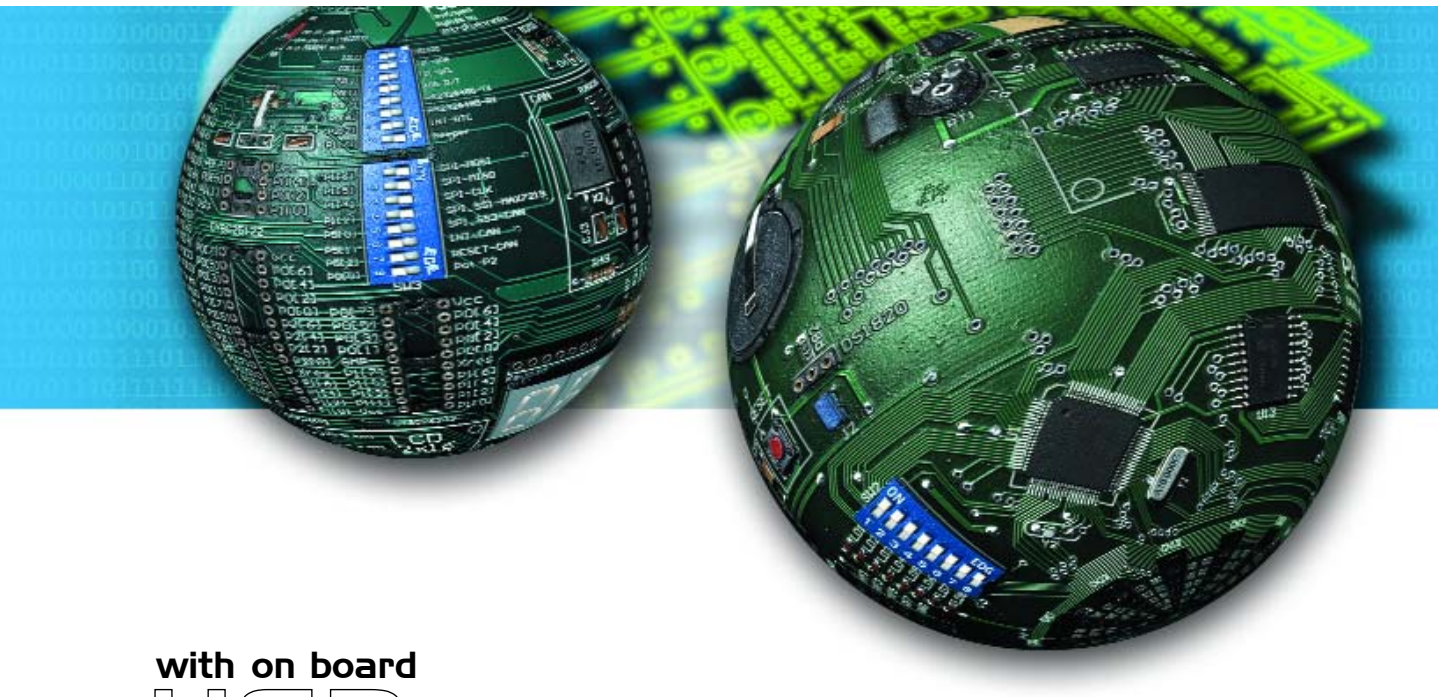
SOFTWARE AND HARDWARE SOLUTIONS FOR THE EMBEDDED WORLD

MikroElektronika
Development tools - Books - Compilers

PICPLC16 User's Manual



with on board
USB
2.0 programmer

PICPLC16 is a system designed for controlling industrial systems and machines. 16 inputs with optocouplers and 16 relays (up to 10A) can satisfy many industrial needs. PICPLC16 can serve as remote control system by means of RS-485 communication.

Software and Hardware
solutions for Embedded World

First edition
November
2005

No part of this manual, including the product and software described in it, may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language in any form or by any means, except documentation kept buy the purchaser for backup purposes, without the express written permission of MikroElektronika company.

Product warranty or service will not be extended if the product is repaired, modified or altered, unless such repair, modification or alteration is authorized in writing by MikroElektronika.

MIKROELEKTRONIKA PROVIDE THIS MANUAL "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PUROSE.

IN NO EVENT SHALL MIKROELEKTRONIKA, ITS DIRECTORS, OFFICERS, EMPLOYEES OR DISTRIBUTORS BE LIABLE FOR ANY INDIRECT , SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES(INCLUDING DAMAGES FOR LOSS OF PROFITS, LOSS OF BUSINESS, LOSS OF USE OR DATA, INTERRUPTION OF BUSINESS AND THE LIKE) EVEN IF MIKROELEKTRONIKA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES ARISING FROM ANY DEFECT OR ERROR IN THIS MANUAL OR PRODUCT.

SPECIFICATION AND INFORMATION CONTAINED IN THIS MANUAL ARE FURNISHED FOR INTERNATIONAL USE ONLY, AND ARE SUBJECT TO CHANGE AT ANY TIME WITHOUT NOTICE , AND SHOULD BE CONSTRUED AS A COMMITMENT BY MIKROELEKTRONIKA

MikroElektronika assumes no responsibility or liability for any errors or inaccuracies that may appear in this manual, including the product and software described in it.

Product and corporate names appearing in this manual may or may not be registered trademarks or copyrights of their respective companies, and are used only for identification or explanation and to the owners benefit, without intent to infringe.

CONTENTS

CONNECTING THE SYSTEM page 4

INTRODUCTION page 5

DESCRIPTION OF THE DEVELOPMENT SYSTEM page 6

Jumpers page 6
MCU socket page 7
Power Supply page 9
Power Supply Supervisor & Reset circuit page 11
On-board USB programmer page 12
RS-232 Communication page 14
RS-485 Communication page 16
PS/2 (Keyboard) connector page 18
Optocouplers page 19
Releys page 21
Direct port access page 23

CONNECTING THE SYSTEM

The development system box contains a development system, CD, USB cable and serial cable.

Step no.1 The first thing to do is to take the system out of a box. Unpack the USB cable and connect it to the PC. Please use USB ports from the back of the PC, with direct contact to the motherboard.

Step no.2 Connect MCU power supply to the PICPLC16 board.

Step no.3 Connect the USB cable to the PICPLC16 board.

Step no.4 The PC will start the procedure for installing the USB driver for the on-board USB 2.0 programmer. Follow the procedure from the document ' *Installing Driver for USB programmer'* and install the USB driver.

Step no.5 Copy PICFLASH2.exe file to the folder of your choice. You can find this file in the PICFLASH folder on the CD.

Step no.6 Run and use PICFLASH2 as explained in the document '*PICflash programmer*'.

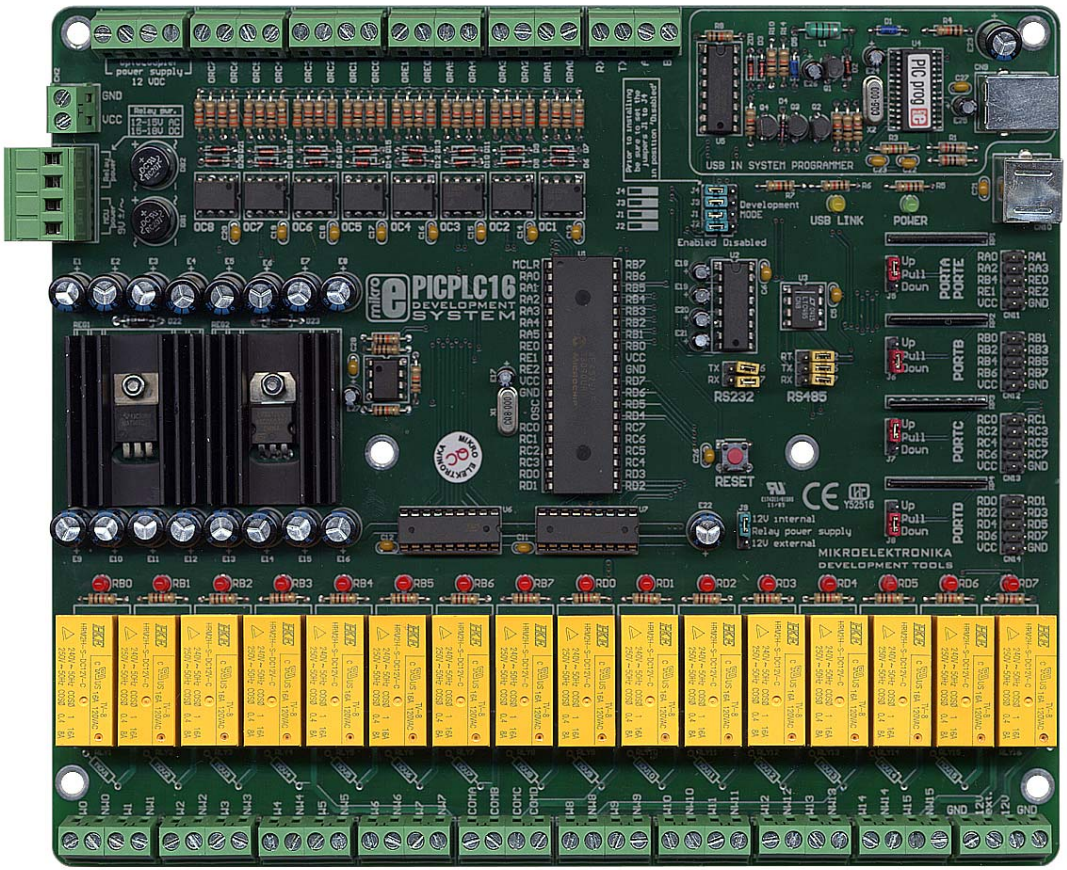
After these 6 steps, your PICPLC16 is installed and ready for use. You should try to read a program from the chip or to load an example from the examples folder.

INTRODUCTION

The PICPLC16 development system is a industrial development board for Microchip PIC microcontrollers. It allows PIC microcontrollers to be interfaced with external circuits and a broad range of peripheral devices, allowing the user to concentrate on software development.

Figure 1 illustrates the development board. On a silkscreen, there are identification marks beside each component. These marks describe connections to the microcontroller, operation modes, and provide some useful notes. The need for additional schematics is minimized as all the information is printed on the board.

Figure 1. PICPLC16 development board



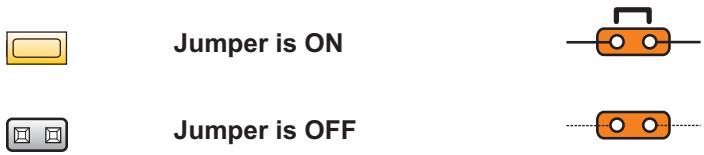
JUMPERS

Jumpers can break or establish a connection between two points. Beneath the plastic cover of the jumper is a metal contact, which makes a connection when the jumper is placed between two disconnected pins.

For example J14 is used to connect or disconnect Tx line for RS-232 Communication. Connection is made when the jumper is placed between two contacts.

Figure 2.

Jumper as a switch

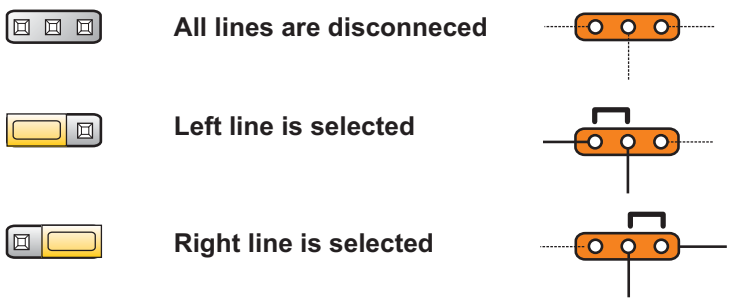


More often, jumpers are used as a selector between two possible connections using a three pin connector. As illustrated in Fig. 3, middle connector can be connected to the left or right pin, depending on the jumper's position.

.

Figure 3.

Jumper as a multiplexer



MCU SOCKET

The PICPLC16 development board support a 40-pin microcontrollers in DIP40 package as shown on the following picture:

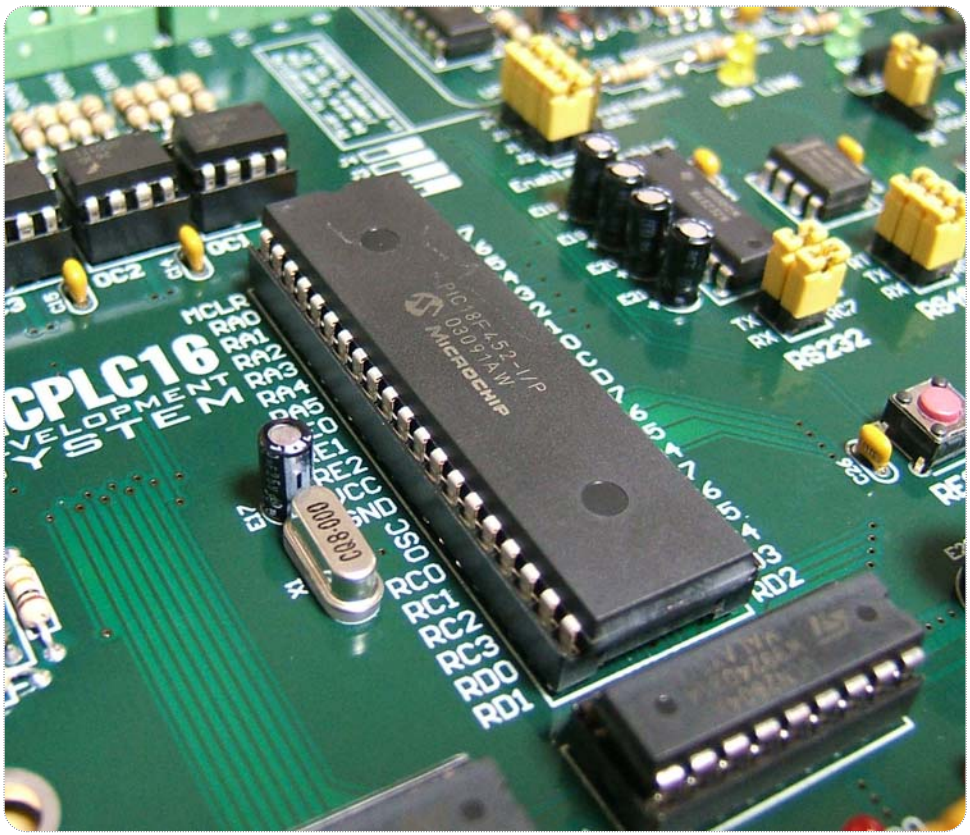
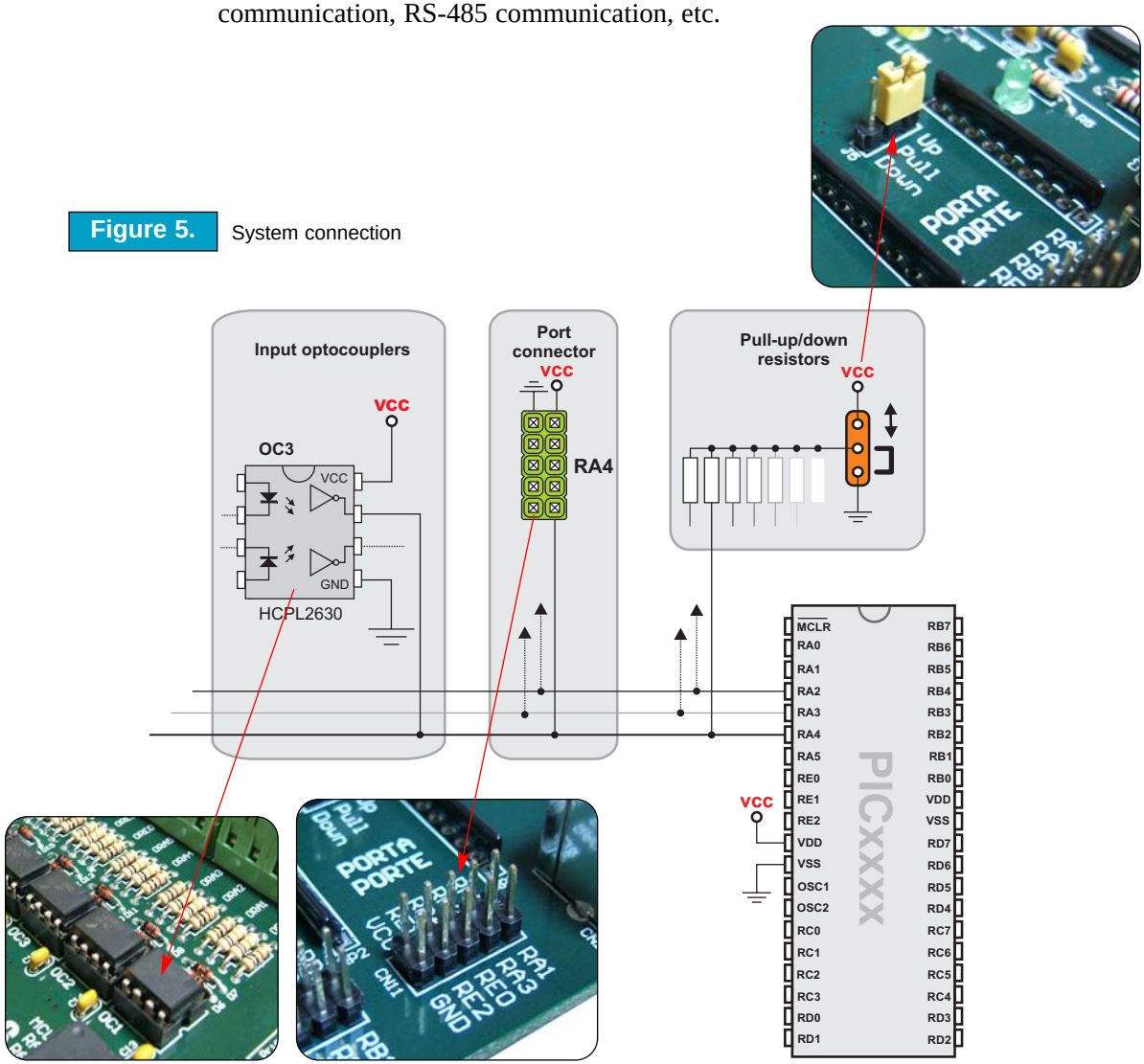


Figure 4. MCU socket

The microcontroller's pins are routed to various peripherials as illustrated in Figure 5. All ports have direct connections to Direct Port Access connectors. Such connectors are typically used for connecting external peripherials to the board, or for providing useful points for connecting digital logic probes.

Some of the pins are connected to other peripherials such as optocouplers, RS-232 communication, RS-485 communication, etc.

Figure 5. System connection

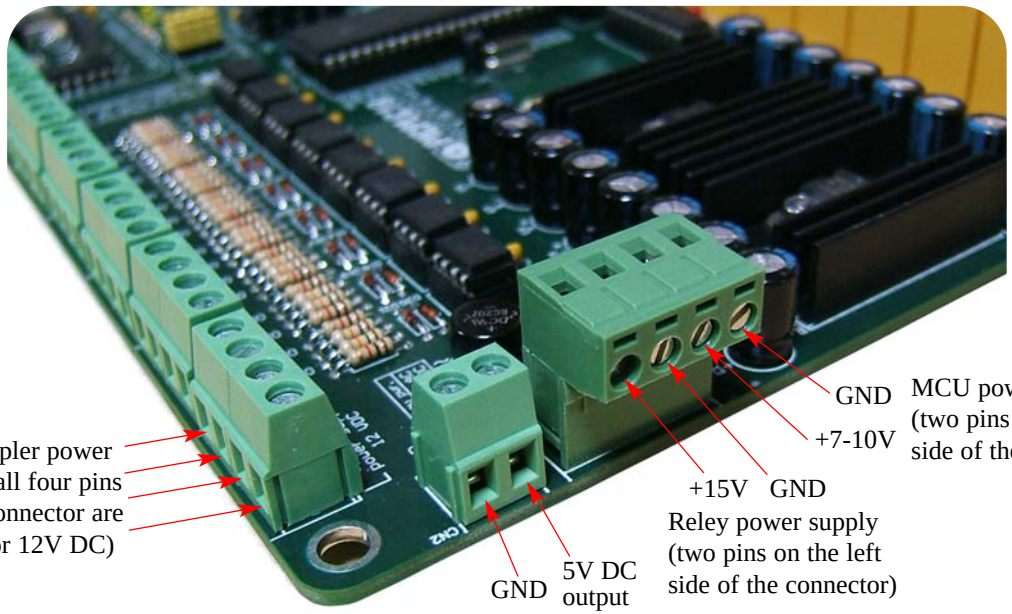


POWER SUPPLY

PICPLC16 have three kind of power supply - MCU power supply, reley power supply and optocoupler power supply.

The MCU power supply can be AC or DC, with a voltage between 8V and 16V. The reley power supply can be AC with a voltage between 12V and 15V, or DC with voltage between 15V and 18V. Optocoupler power supply is 12V DC. In Figure 6 and Figure 7 you can see power supply connectors.

Figure 6. MCU, reley and optocoupler power supply connectors


Optocoupler power supply (all four pins on the connector are inputs for 12V DC)
GND
+7-10V
MCU power supply (two pins on the right side of the connector)
+15V
GND
Reley power supply (two pins on the left side of the connector)
GND
5V DC output

External reley power supply connector **Figure 7.**

Reley power supply can be internal or external. In case of external power supply 12V DC must be connected to two pins on the left side of the connector which is placed on the lower right side of the development board. Selection is made with jumper J9 as shown on the next page.

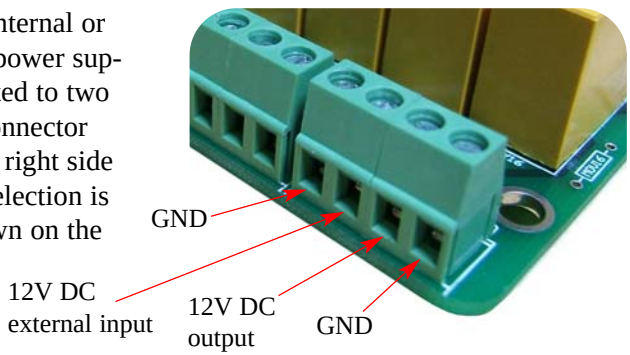
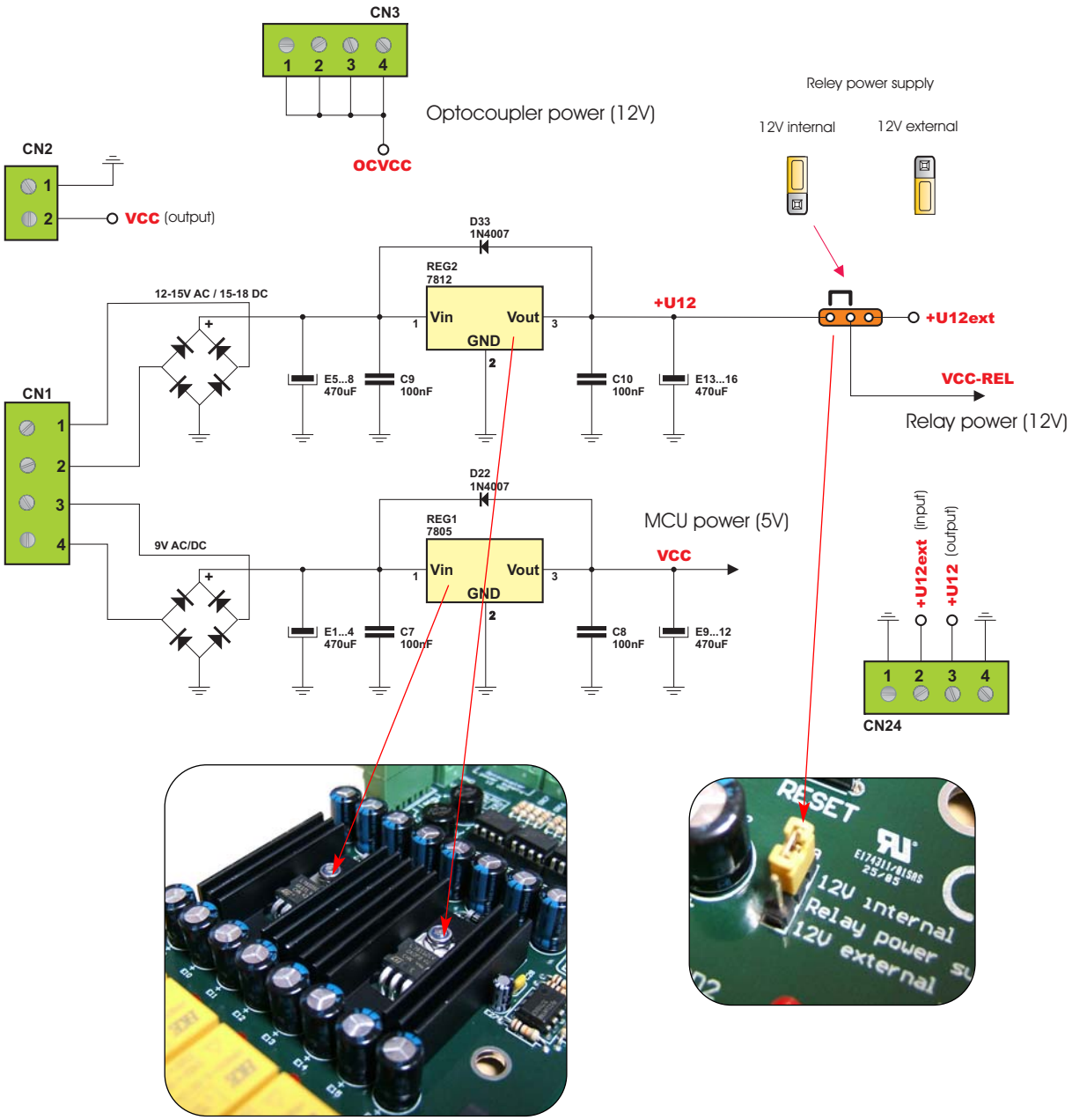


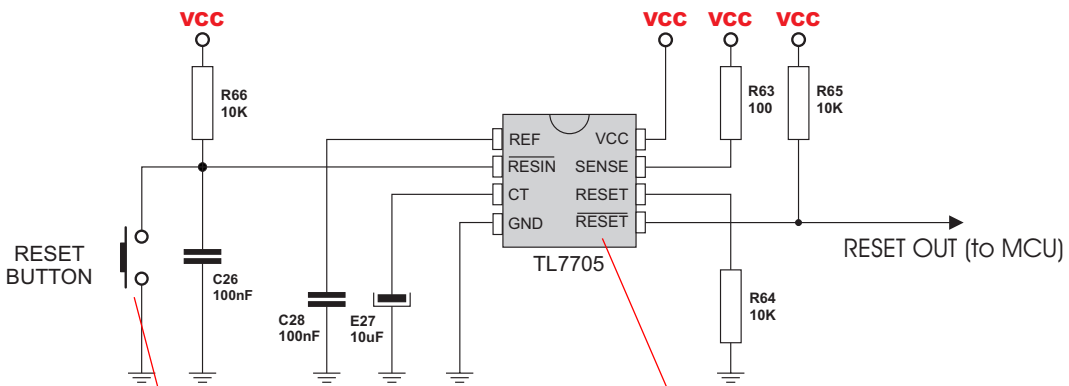
Figure 8. Power supply schematic



POWER SUPPLY SUPERVISOR & RESET CIRCUIT

In the industrial enviorment it is very important to have reliable device that will continue working on every posible condition. The most important component on every electronic device is a stabile power supply, but in the harsh enviorment there can be some deviance from nominal values. Power supply supervisor monitor power supply level and restart the microcontroller if the level is to low or to high. Reset button is also connected to power supply supervisor, which generates reset signal when button is pressed.

Figure 9. Power supply supervisor schematic



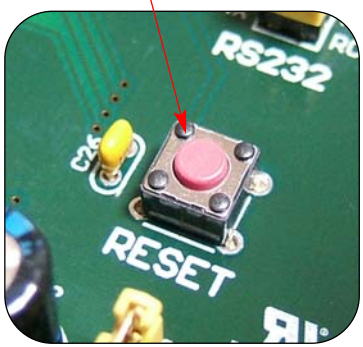


Figure 10. Reset button

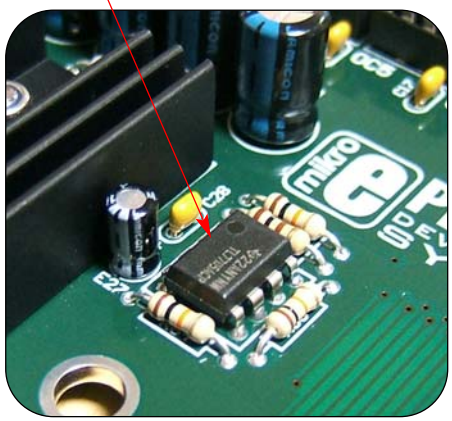
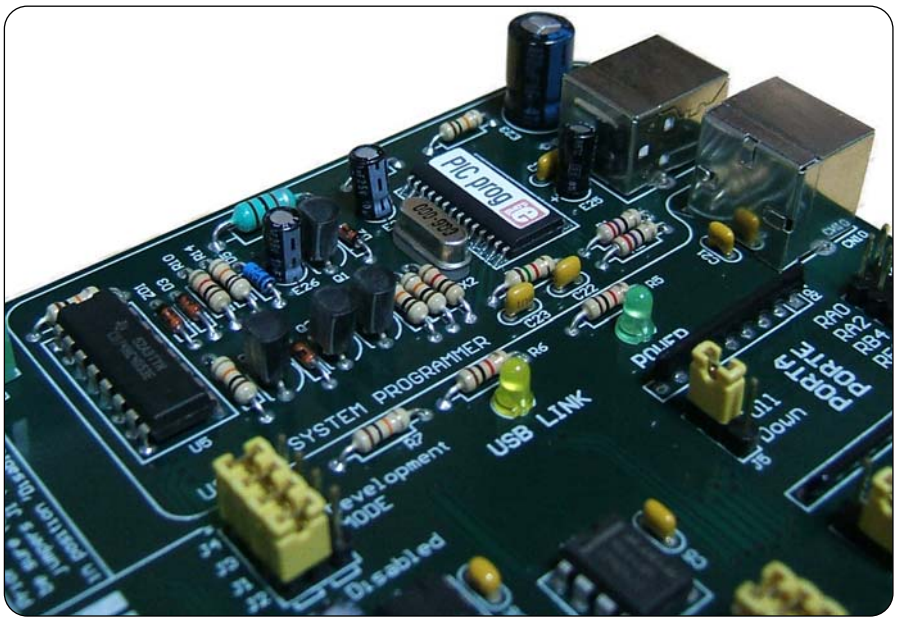


Figure 11. Power supply supervisor

ON-BOARD USB PROGRAMMER

There is no need for the use of external equipment during programming, as the PICPLC16 development system has its own on-board USB programmer.

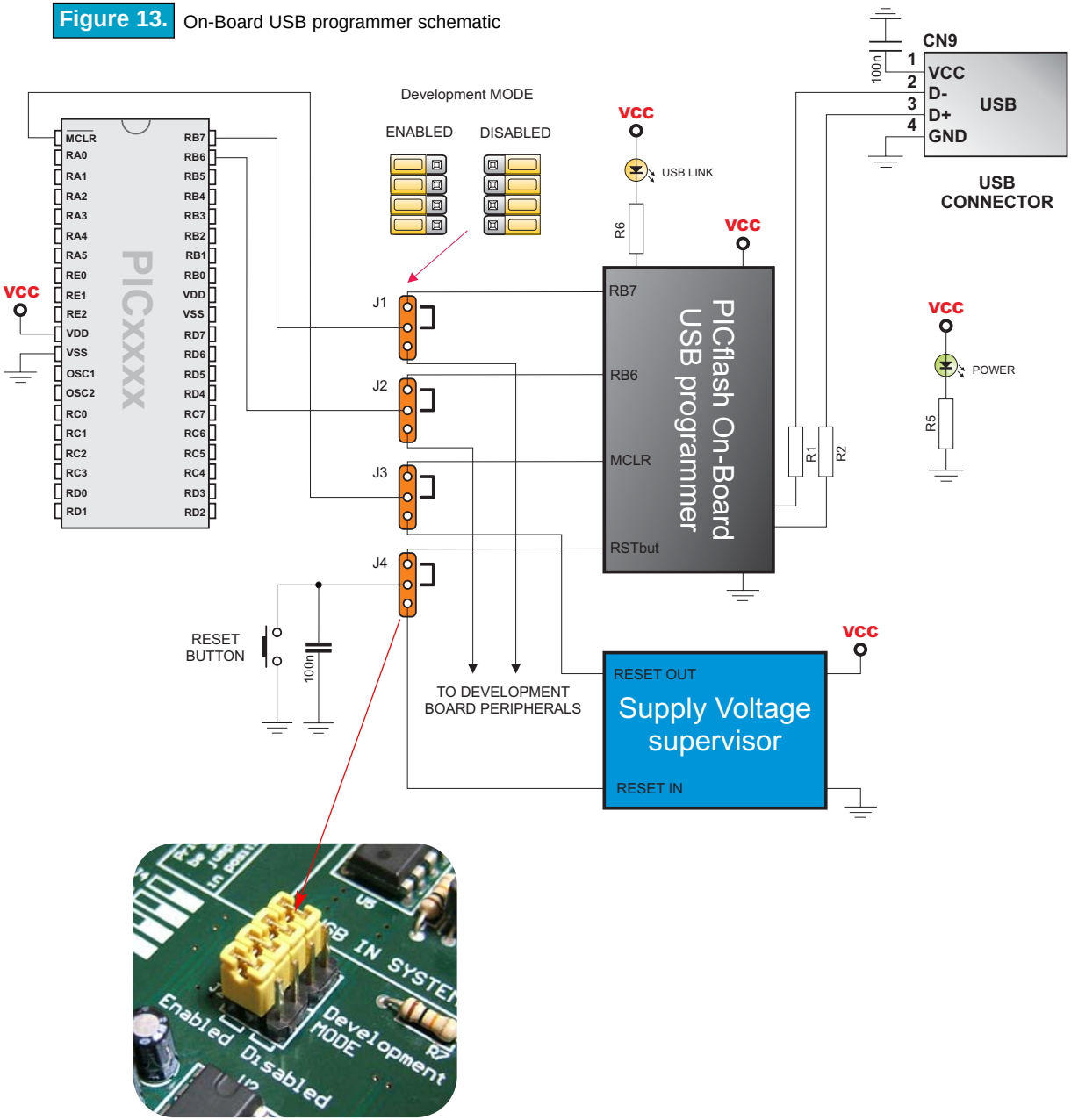
All you need to do is connect MCU power supply to development board, connect the system to a PC using the USB cable, and enable Development MODE by setting jumpers J1, J2, J3 and J4 to the left side position. Then, load your program into the microcontroller via the *PICflash2* programming software, which is supplied with the board.



On-Board USB programmer **Figure 12.**

By enabling or disabing Development MODE you connect or disconnect the programmer from the rest of the board. That is very important when working in industrial enviorment, where application of PICPLC16 can include high voltages and/or currents and do possible damage to programmer (the programmer is secured by disabling Development MODE!).

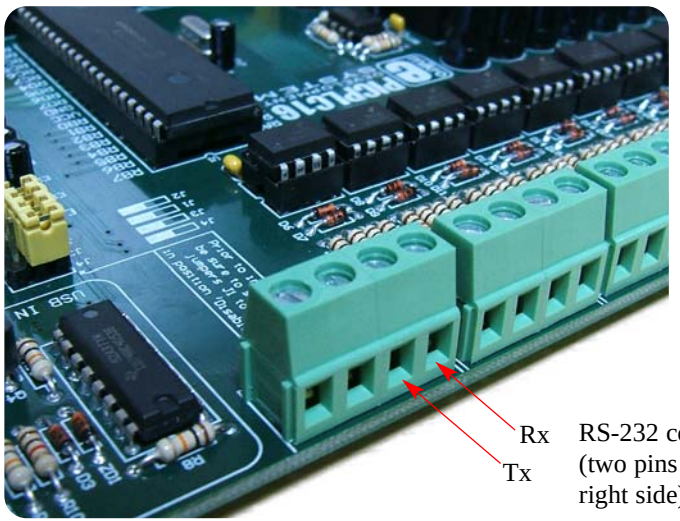
Figure 13. On-Board USB programmer schematic



RS-232 COMMUNICATION

RS-232 communication enables point-to-point data transfer. It is commonly used in data acquisition applications, for the transfer of data between the microcontroller and a PC. Since the voltage levels of a microcontroller and PC are not directly compatible with each other, a level transition buffer such as the MAX232 must be used.

Figure 14. RS-232 connector



PICPLC16 development board have one RS-232 communication device. In order to provide a more flexible system, the microcontroller is connected to the MAX232 through two jumpers. Jumper J13 and J14 are used to connect Rx and Tx lines from microcontroller to RS-232 port.

RS-232 jumpers **Figure 15.**

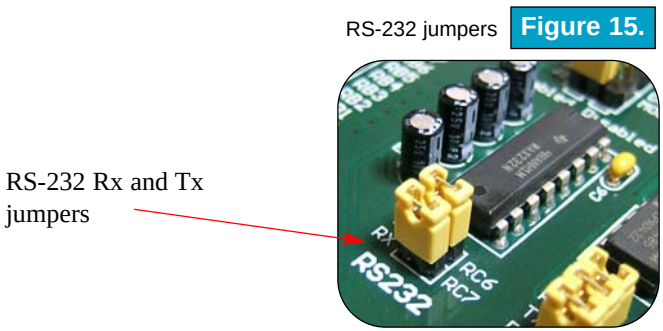


Figure 16.

RS-232 Schematic and connection to the PC

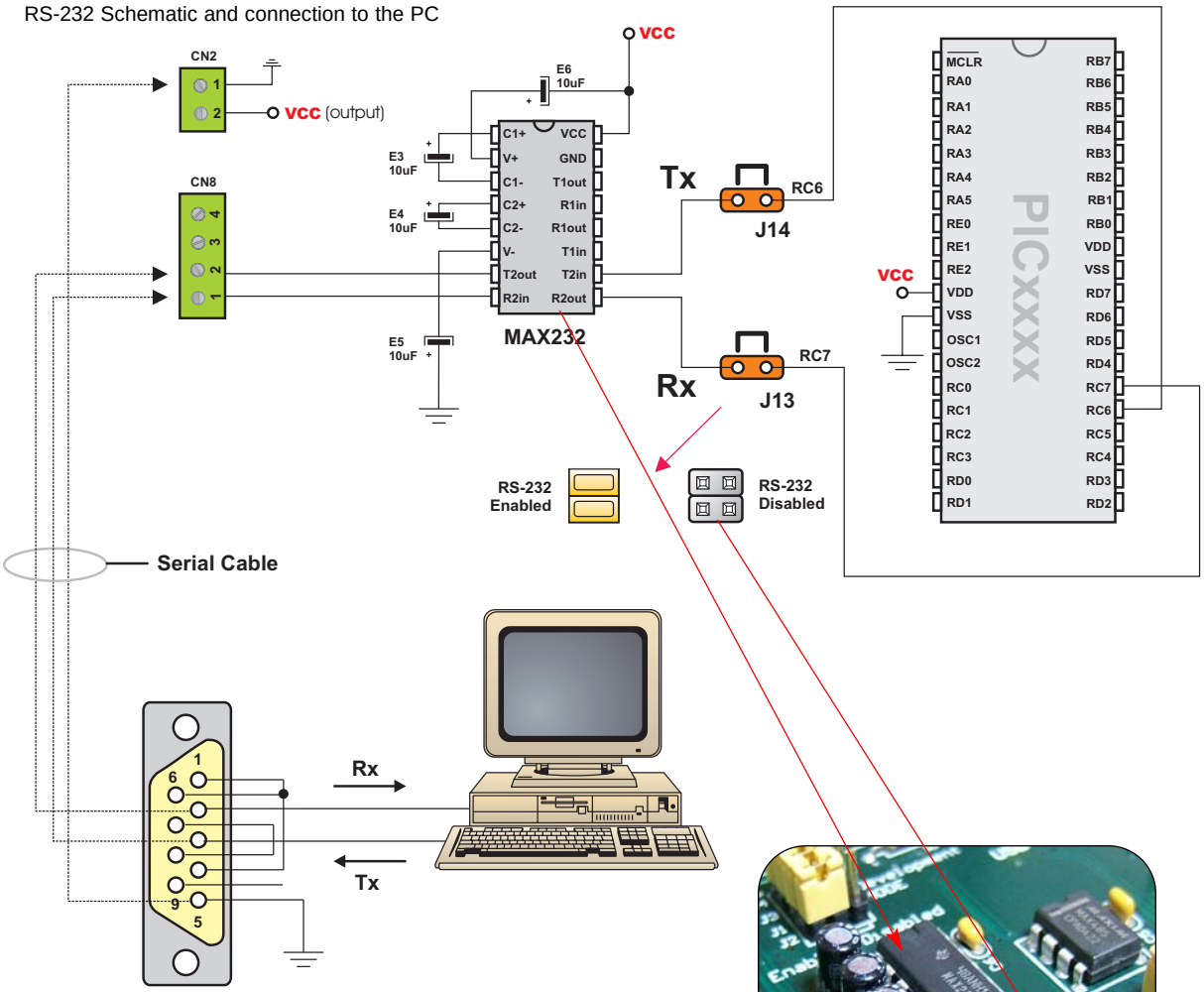
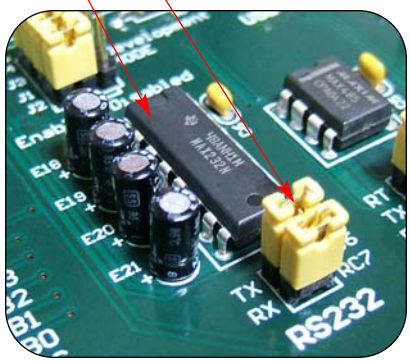


Figure 17.

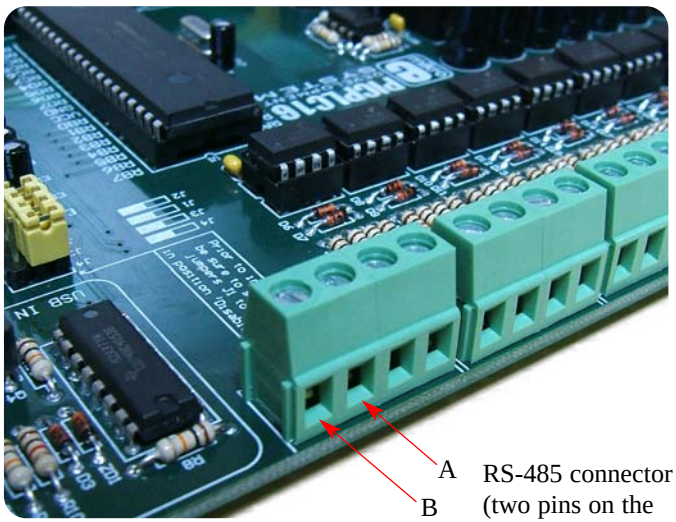
RS-232 jumpers and MAX232 chip



RS-485 COMMUNICATION

RS-485 communication enables point-to-point and point-to-multipoint data transfer. It is commonly used for data transfer between several microcontrollers. LTC485 interface tranciever is used for transforming signal from microcontroller's Rx and Tx lines to differential signal on A and B output lines.

Figure 18. RS-485 connector



PICPLC16 development board have one RS-485 communication device. In order to provide a more flexible system, the microcontroller is connected to the LTC485 through three jumpers. Jumper J10, J11 and J12 are used to connect Rx, Rt and Tx lines from microcontroller to RS-485 port.

RS-485 jumpers **Figure 19.**

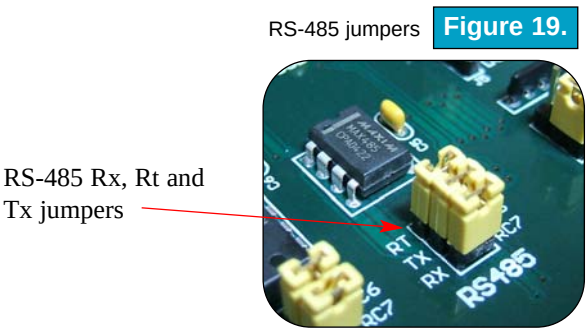
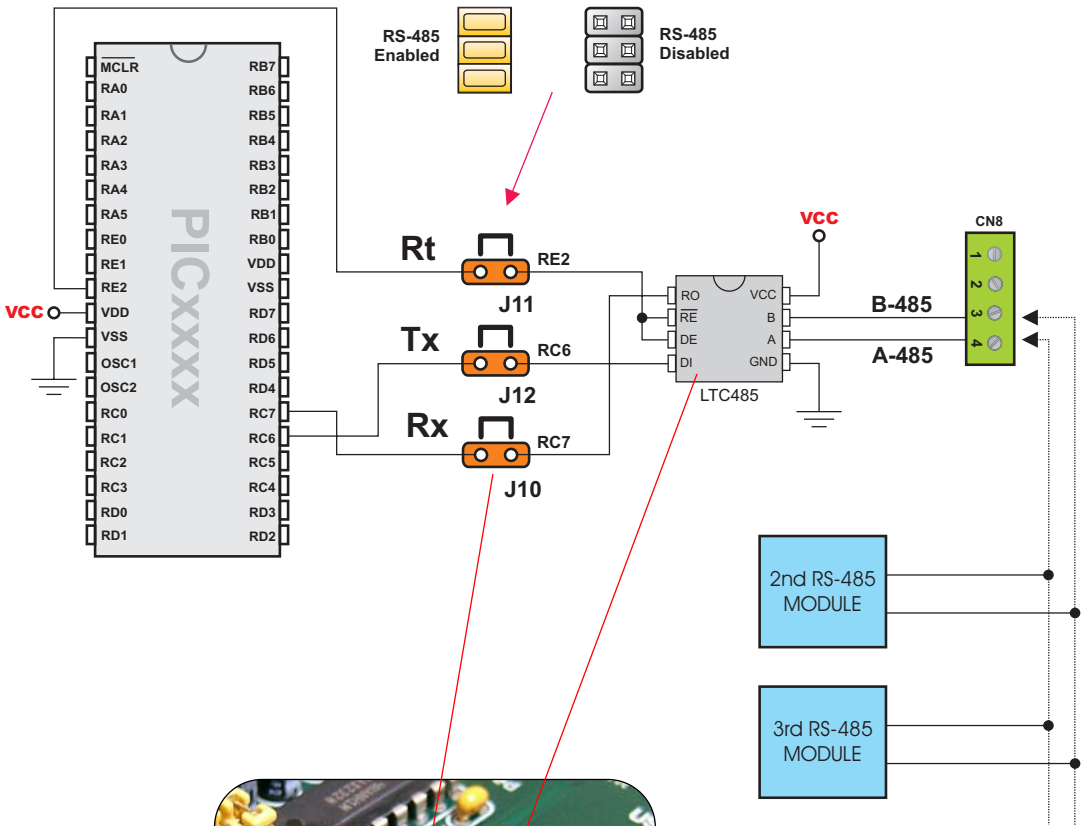


Figure 20. RS-485 schematic and connection to other RS-485 modules



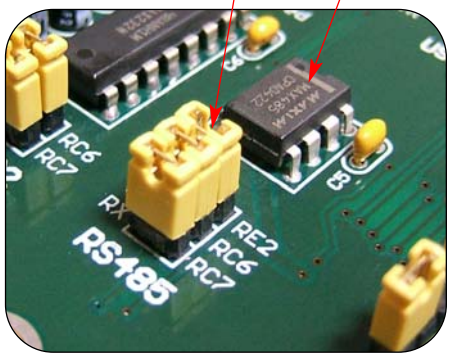


Figure 21.
RS-485 jumpers and LTC485 chip

PS/2 (KEYBOARD) CONNECTOR

Keyboards consist of a large matrix of keys, all of which are monitored by an on-board processor (called the "keyboard encoder".) The specific processor varies from keyboard-to-keyboard but they all basically do the same thing: Monitor which key(s) are being pressed/released and send the appropriate data to the MCU. This processor takes care of all the debouncing and buffers any data in its 16-byte buffer, if needed. All communication between the host and the keyboard uses an IBM protocol.

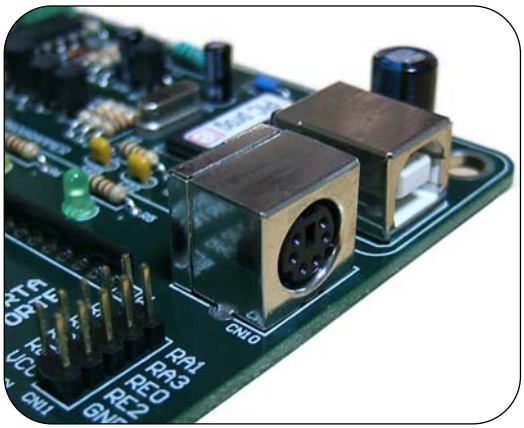


Figure 22.

PS/2 (Keyboard) connector

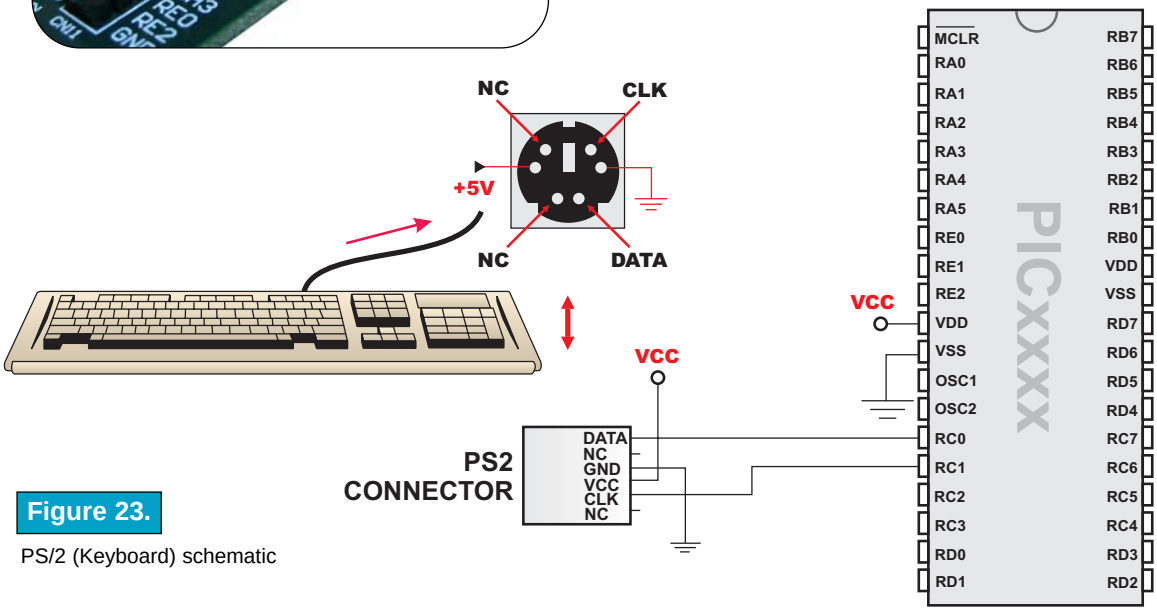


Figure 23.

PS/2 (Keyboard) schematic

OPTOCOUPLERS

PICPLC16 have 16 optocouplered inputs. It is widely used in industrial applications where inputs must be galvanized (electrically isolated from the rest of the development board). All that is done to protect microcontroller from electrical pulses that might occur on input lines.

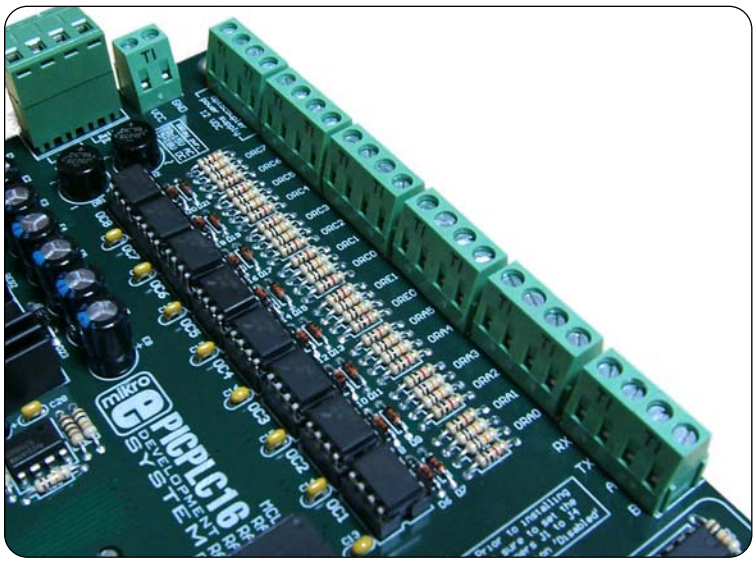


Figure 24.

Optocouplers and their connectors

In order to be electricaly isolated from the rest of the board, input circuit must have it's own power supply (12V DC). Optocoupler chip have two LED's on the input and two open collector transistors on the output pins. First 8 optocoupler outputs are connected to microcontroller's RA(E) port and second 8 outputs are conected to microcontroller's RC port. Ports RA(E) and RC must be on high level eg. they must be pulled-up by putting jumpers J5 and J7 on upper position.

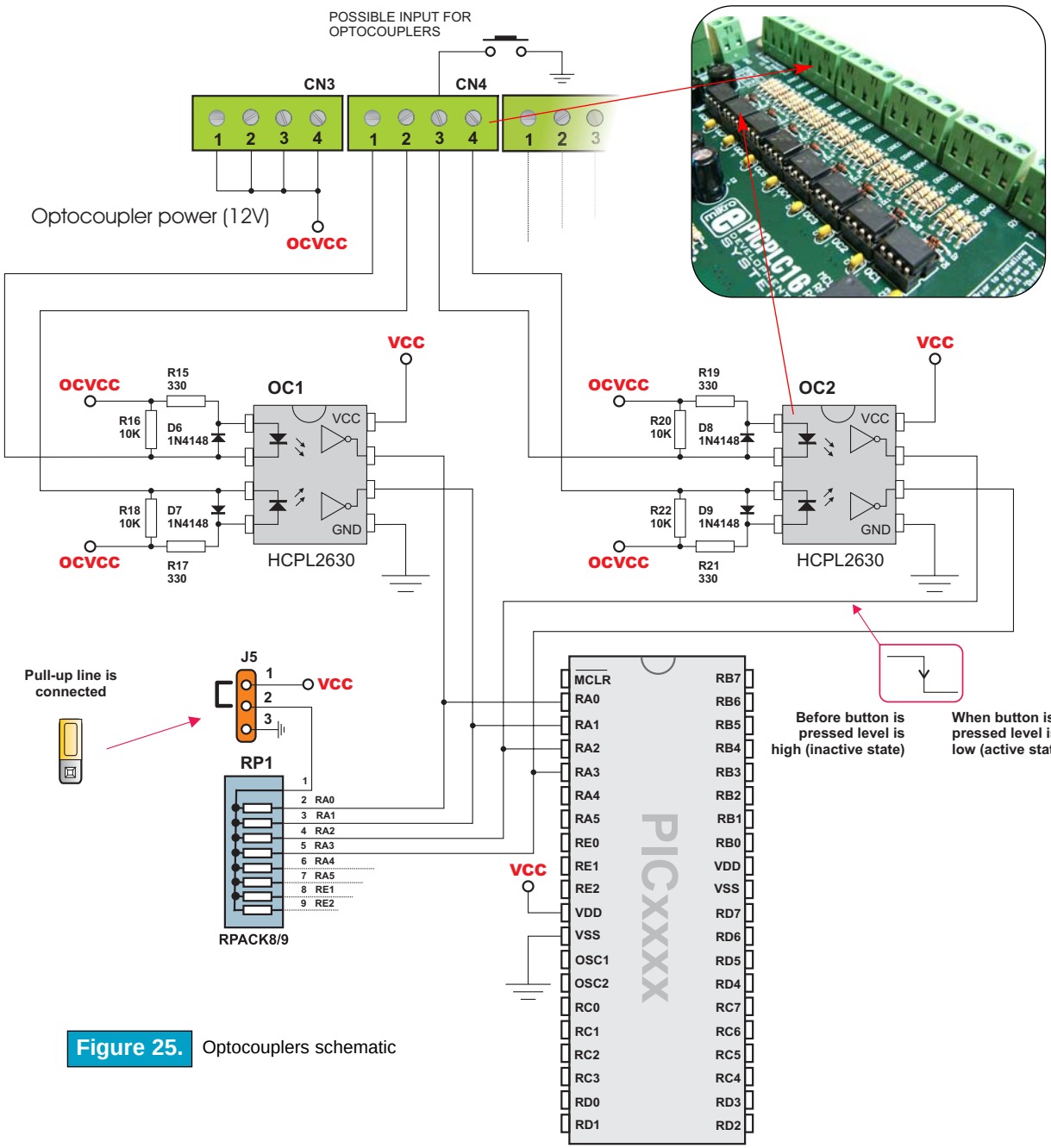


Figure 25. Optocouplers schematic

RELEYS

In order to control devices that operates on high voltage and/or current, PICPLC16 have 16 releys connected to microcontroller ports RB and RD. Because releys have higher operating voltage and higher current consumption they have separated power supply (12V DC). It can be internal when connected together with MCU power supply or external. You select one of these two power supplies by setting jumper J9 in appropriate position.

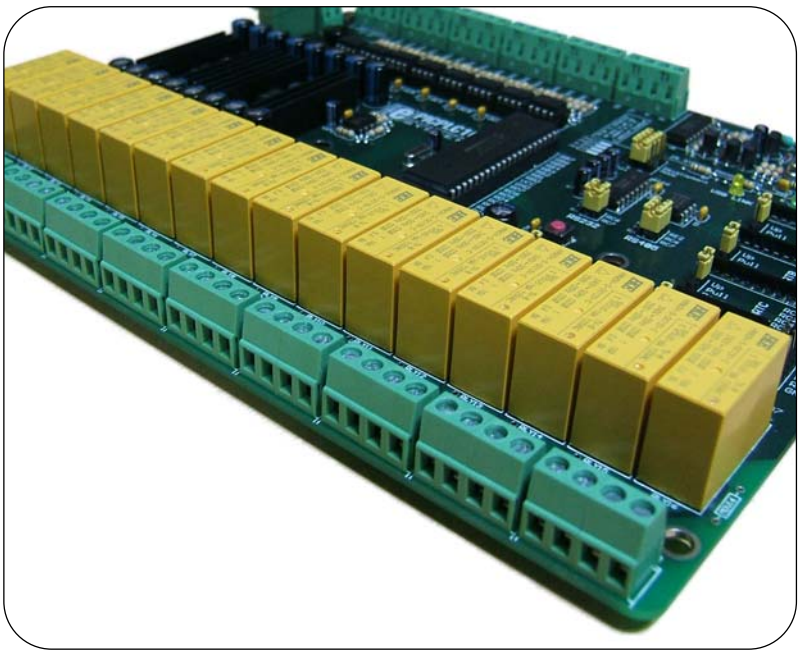
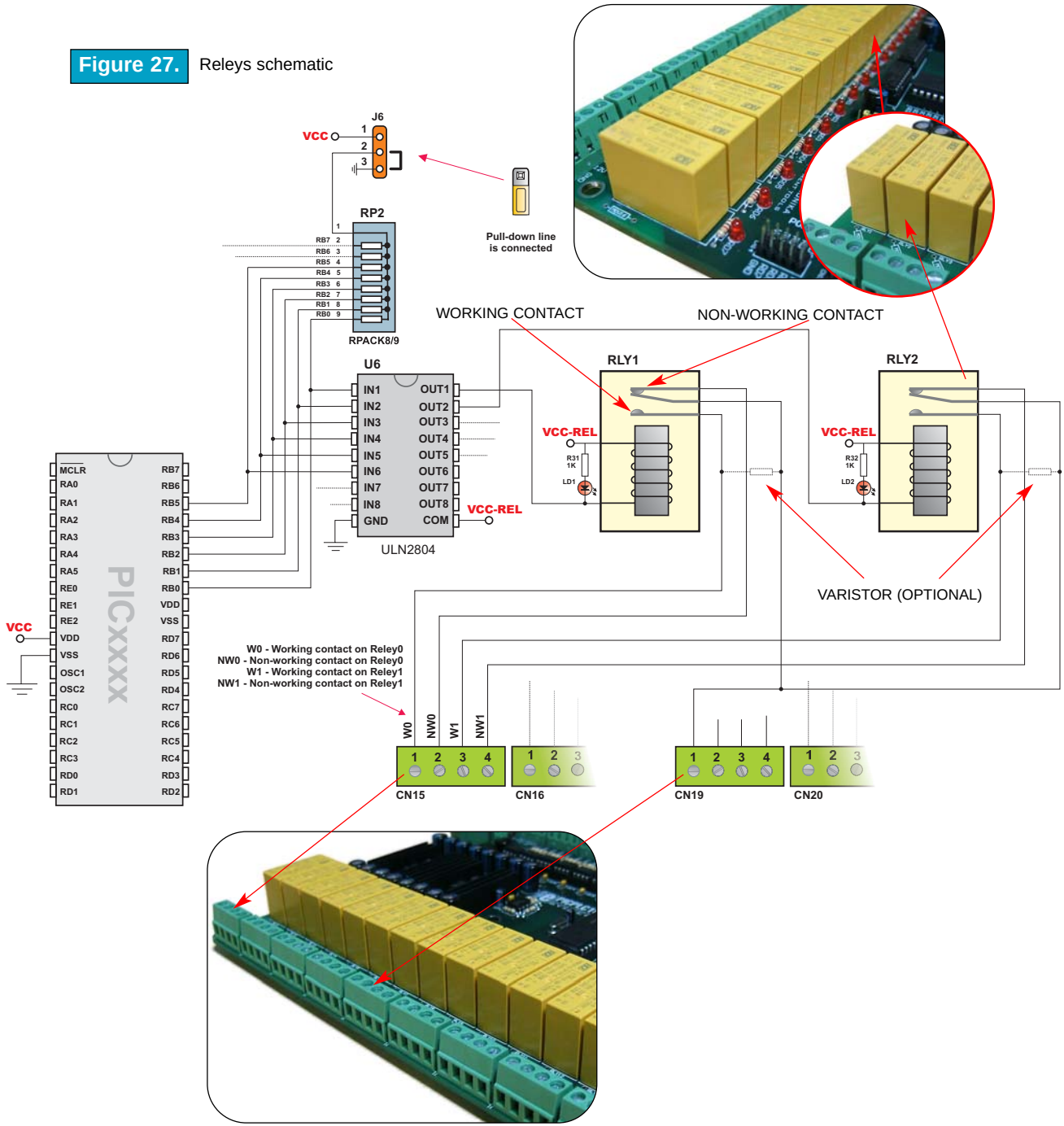


Figure 26.

Releys and their connectors

Microcontroller's ports RB and RD can't provide necessary current for direct driving of releys so they are connected to ULN2804 Darlington drivers. Ports RB and RD must be on low level eg. pulled-down so the releys are switched on when microcontroller puts logical one on their outputs. Each releys have one LED indicator connected parallel to him so it shows when releys is switched on. There are three contacts on releys's output: working contact, non-working contact and common contact. Common contacts of every four releys are also provided on development board connectors. Optionaly you can add varistor to development board depending on releys's working voltage and current (it is connected between working and common contacts).

Figure 27. Releys schematic



DIRECT PORT ACCESS

All microcontroller input/output pins can be accessed via connectors placed along the right-hand side of the board. For each of the ports RA(E), RB, RC and RD there is one 10-pin connector providing Vdd, GND and up to eight port pins.

These connectors can be used for system expansion with external boards such as Compact Flash, CAN, serial GLCD etc. Ensure that the on-board peripherials are diconnected from microcontroller by setting the appropriate jumpers, while external peripherals are using the same pins. The connectors can also be used for attaching logic probes or other test equipment.

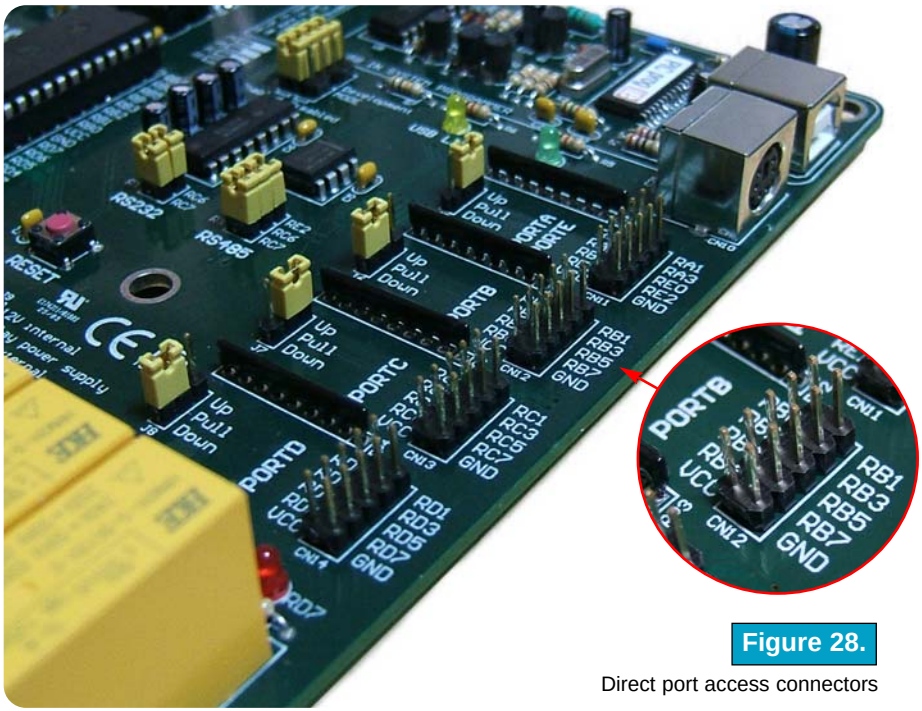


Figure 28.
Direct port access connectors

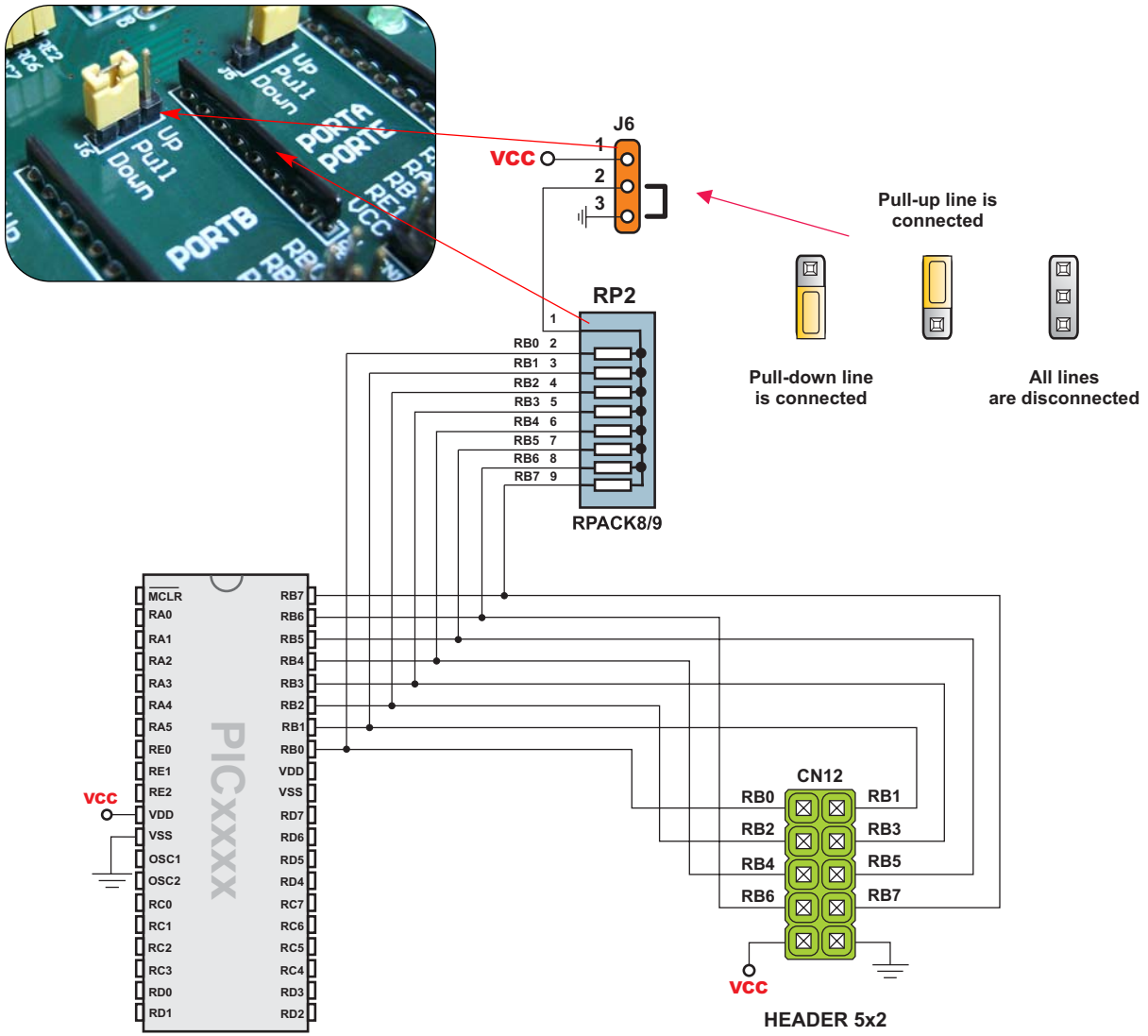


Figure 29.

Port B connection to microcontroller

If you are experiencing problems with any of our products or you just want additional information, please let us know. We are committed to meet every your need.

Technical Support :
support@mikroe.com

If you have any other question, comment or a business proposal, please contact us:

E-mail: ***office@mikroe.com***
Web: ***www.mikroe.com***